5.1 Remotely Piloted Vehicles and Miniaturized Sensors

Technology Need

The idea of using remotely piloted vehicles for aerial photography and remote sensing is not new. But many of the current aerial platforms, most of which were developed for military applications, are complicated to operate and expensive to maintain, consequently of little use in environmental restoration.

This technology adapts ordinary, readily available, model airplanes and helicopters that cost less than a thousand dollars, can be flown by any radio-control hobbyist, yet can carry a 5-10 lb sensor payload.

Figure 5.1-1. As originally constructed, this modified "Telemaster" was built to carry a 35 mm camera. Currently, we are working to add GPS autopilot, data telemetry and geophysical sensors.

Technology Description

Remote sensing techniques, such as aerial photography, multispectral scanning, and airborne geophysics, are of unquestioned value for hazardous waste site characterization, facility monitoring, and clean-up verification. But remote sensing is often dismissed as too expensive unless the waste site is large enough to justify the system mobilization and data processing costs. The goal is to demonstrate that for small sites, a radio-controlled airplane or helicopter can be used to collect high-quality data quickly and cheaply (see Figure 5.1-1).

For example, when new buildings or roads are constructed at an active disposal site, existing aerial photographs become dated, making it more difficult for the facility manager to plan further work. But by using a small, radio-controlled airplane, equipped with an ordinary 35 mm camera and a video viewfinder, a new aerial photograph of the site can be taken immediately, eliminating the cost and inconvenience of hiring a helicopter or fixed-wing aircraft. With minimal effort, a whole series of aerial photographs could be taken to document activities at the burial ground.

Task efforts are not limited to photography. A new generation of lightweight, low-power sensors is being developed by the Office of Science and Technology, including magnetometers and electromagnetic sensors. These new sensors offer exciting new applications for airborne miniature platforms.

Benefits

Our current efforts are focused on equipping a model plane with a miniature magnetometer, similar to those currently used by geophysicists in land-based surveys to look for buried drums and waste trenches, and a Very Low Frequency (VLF) electromagnetic sensor being designed by the United States Geological Survey (USGS). Radiation sensors and chemical vapor monitors are examples of other sensors which may be added in the future.

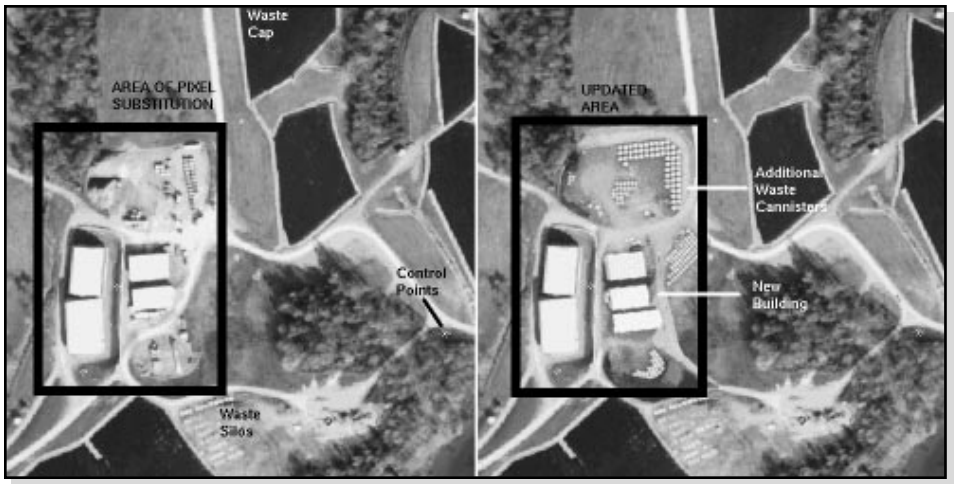

Figure 5.1-2 Aerial photographs of Solid Waste Storage Area 6 on the Oak Ridge Reservation. The photograph on the left is out- of-date; the boxed area has changed since this photograph was taken in 1990. The photograph on the right has been updated using an aerial photograph taken with the plane pictured in Figure 5.1-1. Using commercially available software, the boxed area has been digitally substituted into the older photograph to produce an updated aerial photograph.

Collaboration/Technology Transfer

There has been considerable interest in this project expressed by both the Office of Environmental Restoration (EM-40) workers and model aircraft manufacturers. We are currently collaborating with researchers at the USGS, Georgia Tech, BAI Aerosystems, Geophex, Brigham Young University, and the University of Texas, Arlington. A special session is being organized at the July 1996 meeting of the Association for Unmanned Vehicle Systems International (AUVSI).

Accomplishments

Figure 5.1-2 shows a 1000 x 1000 ft section of an aerial photograph taken in 1990 of Solid Waste Storage Area 6, an active burial ground on the Oak Ridge Reservation. Since then, a new building has been constructed. We used the plane shown in Figure 5.1-1 to take a new aerial photograph; this newer image was then rectified and substituted into the digital version of the original aerial photograph. The results are shown in Figure 5.1-2.

TTP Information

Remotely Piloted Vehicles and Miniaturized Sensors technology development activities are funded under the following Technical Task Plan (TTP):

TTP No. OR15C241 "Remotely Piloted Vehicles and Miniaturized Sensors"

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Bibliography of Key Publications

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